Quasi-Crystalline Undercooled Alloys for Space Investigation (QUASI)

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Objective:

- Determine the influence of liquid and solid short-range order on the nucleation barrier
- Determination the composition dependence of nucleation rate and evaluate a new coupled flux model for nucleation
- Correlate the nucleation kinetics with the local structure of the liquids
- Correlate the local structure with containerless measurements of thermophysical properties
- Determine changes in the growth rate of the solid as a function of the complexity of the solid phase

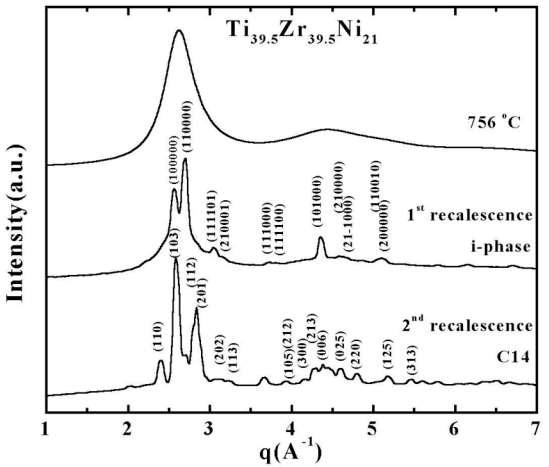
Relevance/Impact:

- Quasicrystals have unique structures holding promise for exciting new alloys. The open structure enables the storage of and controllable release of hydrogen.
- Other potential applications include IR detectors, batteries, and high temperature corrosion resistant coatings

Development Approach:

- Thermophysical properties of quasi- and polyhedral- phase forming alloys will be measured in the undercooled state, and their transformation to crystalline solids observed.
- Sensitivity to impurities from containers will be avoided by the use of levitators – in ground-based studies with an electrostatic levitator and on ISS with a German electromagnetic levitator.
- Many thermophysical properties can be measured in a levitator on Earth, but with convective contamination. This contamination plays a significant role in the formation of the intermediate phases. In particular nucleation and viscosity measurements demand quiescent conditions.

Ground-based Research:



Diffraction patterns taken in levitated undercooled sample within the Argonne synchrotron (BESL). Shows metastable i-phase nucleated from the undercooled liquid

ISS Resource Requirements

Accommodation will be in the Electromagnetic Levitator within ESA's Materials Science Laboratory (MSL-EML).

Columbus Lab. Launch STS-122. MSL/EML to follow.

US PI will supply a small number (1-3) samples. Samples are spheres of 1-3 mm dia.